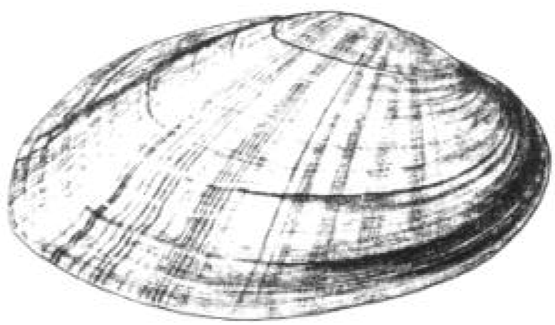
Conservation Assessment
for
Ouachita Kidneyshell (*Ptychobranchus occidentalis*)

Conrad, 1836



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EXECUTIVE SUMMARY

The Ouachita Kidneyshell, *Ptychobranchus occidentalis* (Conrad, 1836) is a medium-sized mussel that is typically found in upland streams of Arkansas, Missouri, Kansas, and Oklahoma. Shells range in thickness and shape across population. The historical range of the Ouachita Kidneyshell probably included northern portions of Texas and Louisiana, but only one record exists for Louisiana and no records exist for Texas. *Ptychobranchus occidentalis* is not listed by the USFWS but is listed as state protected in Kansas and Missouri. *Ptychobranchus occidentalis* is considered bradytictic: spawning occurs in the summer, and the larvae are released the following winter/spring. Host fishes identified to date include *Etheostoma spectabile*, *E. blennioides*, *E. juliae*, and *E. caeruleum*. Factors considered particularly detrimental to the persistence of this species are pollution and siltation, in-stream gravel mining, impoundments and invasive species. Unpublished phylogenetic analyses indicate genetically distinct populations within *P. occidentalis*. Additional information regarding the life history and genetic variation in *P. occidentalis* should be obtained prior to initiation of any captive breeding and re-introduction or translocation projects.

NOMENCLATURE AND TAXONOMY

Ptychobranchus occidentalis (Conrad, 1836) Ouachita Kidneyshell

Synonomy:

Unio occidentalis Conrad, 1836; Conrad, 1836:64, pl. 36, fig. 1.

Ptychobranchus clintonensis Simpson, 1900; Simpson, 1900:79, pl. 5, fig. 3.

Ellipsaria clintonensis (Simpson, 1900); Utterback, 1916: 316, pl. 25, figs. 81a, b.

Ptychobranchus occidentalis (Conrad, 1836); Valentine and Stansbery, 1971: 42, p. 23.

Type Locality: The type locality is listed by Conrad (1836) as the Current River, Arkansas.

DESCRIPTION OF SPECIES

The shell of *P. occidentalis* is oblong in outline and elongate. The ventral margin can be concave, convex or straight. The anterior margin is rounded whereas the posterior margin is somewhat arcuate. The shell is typically quite compressed, and varies in thickness; young specimens are usually thin whereas older shells can be quite thick. Ouachita River specimens also tend to be heavier than those from other streams and more inflated. The beaks are low and do not extend above the hinge line. The posterior ridge is low and broad. The surface of the shell is covered with concentric, faint ridges and some wrinkles. The periostracum typically consists of a tan or yellow-brown background sometimes with a few fine, faint green rays radiating from the umbo. The hinge teeth are noticeably more delicate than those of *P. fasciolaris*. Moderately heavy pseudocardinal teeth are separated from the lateral teeth by a large interdentum. The nacre is white. Hoggarth (1999) described the glochidia of the Ouachita Kidneyshell as subelliptical.

The average length and height are 200 and 238 µm respectively. Micropoints were lanceolate and unorganized and restricted to the narrow ventral flange.

LIFE HISTORY

Ptychobranchus occidentalis is generally found in upland streams in silt, sand, gravel or rocky substrates in slow to moderate currents (Buchanan, 1980, Roe, pers. obs.). It occurs in depths of water from 7.5 cm to ~1 meter (Buchanan, 1980). The marsupium of *P. occidentalis* is restricted to the outer demibranchs, and like other species of the genus takes on a curtain-like appearance when the female is gravid. The Ouachita Kidneyshell produces short, worm-like conglutinates, that are released in the spring (Chamberlain, 1934; Barnhart and Roberts, 1997). The morphology and color of these conglutinates is such that they resemble a larval fish and variation in conglutinate morphology has been observed across populations. Host fishes identified to date include *Etheostoma spectabile*, *E. blennioides*, *E. juliae*, and *E. caeruleum* (Barnhart and Roberts, 1997).

DISTRIBUTION AND ABUNDANCE .

Ptychobranchus occidentalis is found in portions of the Arkansas, Red, White, Black and St. Francis, Osage and Meramec rivers in Kansas, Missouri, Arkansas, and Oklahoma.

RANGE WIDE STATUS

Williams et al. (1993) list *P. occidentalis* as a threatened species. This species has been considered to have occurred in Arkansas, Kansas, Louisiana, Missouri, Mississippi, Oklahoma, and Texas (e.g. Williams et al., 1993). A few records of this species in Missouri dating from the early 20th century are present in museums, although some earlier records from Missouri have been questioned as mislabeled (Obermeyer et al. 1997), and Obermeyer (1999) discusses other potential mis-identifications. Museum records from the early 20th century from Arkansas also were found in museums. Museum records from Kansas date from the 1960's and 1970's, and museum records from Oklahoma date from the 1960's through the 1990's. Curiously, Call (1895) did not include *P. occidentalis* in his Unionidae of Arkansas and apparently confused it with *P. fasciolaris*. Isley (1925) reported this species from Oklahoma from the Red River Drainage and Johnson (1980) and Mather (1990) also list specimens of this species from the Red River drainage in Oklahoma. Vidrine (1993) reported *P. occidentalis* from Bayou Bartholomew just south of the Arkansas state line. No museum records were found for this species in Louisiana and it is unknown if it persists there. Although it is conceivable that this species may have occurred in tributaries of the Red River in Texas, no verifiable records have been found to date, although surveys for mussels in this region are needed (B. Howells, pers. com.). Similarly, records from Mississippi have not been verified. Sizable populations of *P. occidentalis* are still present in Arkansas and Missouri and *P. occidentalis* can still be found in southeastern Kansas in the Verdigris River, and in the Blue and Verdigris rivers in Oklahoma. The Ouachita Kidneyshell is considered threatened in Kansas and imperiled in Missouri, it is not state listed in Arkansas and Oklahoma.

POPULATION BIOLOGY AND VIABILITY

Museum collections of *P. occidentalis* date to the 1960's – 1980's, although monitoring by the states of Kansas and Arkansas indicate that populations in those states still persist. The habitat preferences of the *P. occidentalis* and the availability of that habitat have produced many isolated populations across the historical range of this species. These populations appear to be in the headwaters of the White, Black, Arkansas and Red rivers. Phylogenetic analysis of the genus *Ptychobranchus* (Roe and Cummings, unpublished) indicates the presence of genetically distinct populations within *P. occidentalis*. If the trend of habitat reduction and fragmentation continues the continued loss of genetic variation through genetic drift has the potential to reduce the genetic variation within populations to the point where they may no longer be able to adapt to changing environmental conditions. Any future propagation and reintroduction plans for the Ouachita Kidneyshell should take into account existing genetic distinctiveness and develop management plans that will maintain current genetic variation.

Ptychobranchus occidentalis is one of several recognized species in the genus *Ptychobranchus* although as stated earlier cryptic species may be present within *P. occidentalis* (see above). Members of the genus *Ptychobranchus* produce unique conglutinates and have a distinct marsupium morphology.

POTENTIAL THREATS

Approximately 67% of freshwater mussel species are vulnerable to extinction or are already extinct (National Native Mussel Conservation Committee, 1998). Factors implicated in the decline of freshwater bivalves include the destruction of habitat by the creation of impoundments, siltation, gravel mining and other channel modifications such as dredging, pollution and the introduction of non-native species such as the Asiatic clam and the Zebra Mussel.

<u>Zebra Mussels/*Corbicula*</u>: The introduction and subsequent spread of *Dreissena polymorpha* in the mid to late 1980's has severely impacted native mussel populations in the Lower Great Lakes region (Schlosser et al. 1996). Adverse effects on unionid mussels stem primarily from the attachment of *D. polymorpha* to the valves of native mussels. In sufficient numbers, *D. polymorpha* can interfere with feeding, respiration, excretion, and locomotion (Haag et al. 1993, Baker and Hornbach 1997). It has also been suggested that in high densities zebra mussels could filter unionid sperm or small glochidia from the water column, thus interfering with the mussels' reproductive cycles. It has been estimated that the introduction of *D. polymorpha* into the Mississippi River basin has increased the extinction rates of native freshwater mussels from 1.2% of species per decade to 12% per decade.

Native mussels have shown differential sensitivity to *D. polymorpha* infestations. Mackie et al. (2000) stated that smaller species with specific substrate requirements and few hosts and were long-term brooders were more susceptible than larger species with many hosts, that were short-term brooders. The Ouachita Kidneyshell is a long-term brooder, although its apparent preference for moderately fast flowing streams may serve to limit the exposure of populations of *P. occidentalis* to *D. polymorpha*. Zebra mussels do occur in the mainstem of the Arkansas River as far upstream as eastern Oklahoma, and so have the potential to threaten extant populations of *P. occidentalis* in that drainage. Asian clams (*Corbicula fluminea*) have been implicated as a competitor with native mussels (Neves and Widlak, 1987). Yeager et al. (2001) found that in high densities *C. fluminea* had a negative impact on the survival and growth of juvenile native mussels. Laboratory experiments found that *C. fluminea* will readily ingest glochidia, and that *C. fluminea* density and juvenile mussel mortality is positively correlated.

<u>Gravel Mining</u>: Removal of gravel from a stream has a dramatic impact on stream channel stability as well as water quality (Brown and Curole, 1997). In Arkansas, research has found that instream gravel mining in the Ozark region has altered channels including a decrease in the occurrence of riffle habitats and the abundance of silt sensitive species (Brown and Lyttle, 1992). Infaunal invertebrates are severely affected by removal of substrate and the associated settling of fine sediments disturbed by the mining process (Femmer, 2002). Gravel mining can also result in the creation of unstable stream margins that slough into the stream and create channel instability that can migrate upstream. These phenomena are referred to as headcuts (Hartfield, 1993) and can have a dramatic impact on in-stream faunas.

<u>Siltation</u>: Accumulation of sediments has long been implicated in the decline of native mussels. Fine sediments can adversely affect mussels in several ways. Fine sediments can interfere with respiration, feeding efficiency by clogging gills and overloading cilia that sort food. Excessive sedimentation can reduce the supply of food by interfering with photosynthesis. Heavy sediment loads can also smother juvenile mussels. In addition, sedimentation can indirectly affect mussels by affecting their host fishes (Brim-Box and Mossa, 1999). Strayer and Fetterman (1999) have suggested that fine sediments may be more harmful to mussels in lower gradient streams where sediments can accumulate. In situations where lack of current or seasonal flooding cannot clear away accumulated silt, it is conceivable that interstitial spaces could become clogged with sediment that could potentially suffocate mussels and preclude settlement of juvenile *P. occidentalis*. Obermeyer (1999) notes that *P. occidentalis* was found in "well compacted and relatively clean riffle habitats…with stable sand and gravel substrate" which implies that excessive siltation would have a negative impact on this species.

<u>Pollution</u>: Chemical pollution from domestic, agricultural, and domestic sources were responsible for the localized extinctions of native mussels in North America throughout the 20th century (Baker, 1928, Bogan, 1993). According to Neves et al. (1997) the eutrophication of rivers was a major source of unionid decline in the 1980's, while Havlik and Marking (1987) showed that many types of industrial and domestic substances: heavy metals, pesticides, ammonia, and crude oil were toxic to mussels. Glochidia and juvenile mussels appear to be particularly susceptible to contaminants (Robinson et al. 1996, Jacobson et al., 1997). Although continued chronic exposure to pesticides and other toxicants can have a negative impact on freshwater mussels (Naimo, 1995), acute exposure from chemical spills can have disastrous effects. In a recent spill on the Clinch River over 7,000 individual mussels were killed including three federally listed species (Jones et al., 2001). In 1999 a spill on the Ohio River resulted in the mortality of all

mussels (~1 million individuals) along a 10-mile stretch of river (Butler, 2002). Like many freshwater mussel species that prefer riffle habitats, populations of *P. occidentalis* tend to be small and somewhat isolated from each other. A catastrophic accident such as those that occurred in the Clinch and Ohio rivers has the potential to result in the extirpation of a significant percentage of extant *P. occidentalis*.

Dams/Impoundments: Impoundments whether for navigational purposes or for the generation of power can dramatically affect the habitat of freshwater mussels, particularly those species that inhabit riffles and shoals. Impoundments alter flow, temperature, dissolved oxygen, substrate composition (Bogan, 1993). In addition, they can isolate freshwater mussels from their host fishes thereby disrupting the reproductive cycle. Changes in water temperature can suppress or alter the reproductive cycle and delay maturation of glochidia and juvenile mussels (Fuller, 1974, Layzer et al. 1993). In addition to habitat fragmentation and temperature alteration, the increase in siltation above impoundments alters the substrate making it unsuitable for many species. Dams and impoundments also can serve to obstruct the movement of host fishes of unionid mussels that can have adverse effects on recruitment and long-term survival of freshwater mussels. The potential hosts of *P. occidentalis* identified to date are all darter species and impoundments can restrict in-stream movement of fishes and create habitats unsuitable for darters, which like *P. occidentalis* prefer flowing streams with good current and clean substrates.

PAST AND CURRENT CONSERVATION ACTIVITIES

Plans for the conservation of North American freshwater mussels have generally taken one of two approaches: 1.) the preservation of existing populations and allow the mussels to re-invade historical ranges naturally and 2.) to actively expand the existing ranges by re-introducing mussels through translocation from "healthy" populations or from captive rearing programs (NNMCC, 1998). The second strategy is the more pro-active, and may ultimately prove to be effective, however several important factors should not be over-looked. Before translocations or re-introductions occur it should be established that conditions at the re-introduction site are suitable for the survival of mussels. Mussel translocation projects have had mixed success (Sheehan et al. 1989, Cope and Waller, 1995). Re-introducing mussels into still contaminated or otherwise un-inhabitable habitat is a waste of resources and can confound attempts to obtain unbiased estimates of the survival of species after re-introduction. Additionally, the genetic variation across and within populations should be assessed prior to the initiation of a reintroduction/translocation scheme (Lydeard and Roe, 1998). Evaluation of the genetic variation is crucial to establishing a captive breeding program that maintains the maximal amount of variation possible and avoid excessive inbreeding (Templeton and Read, 1984) or outbreeding depression (Avise and Hamrick, 1996). Genetic data collected to date has revealed some significant genetic variation occurs within and between populations of *P. occidentalis* (Roe and Cummings, unpubl.).

Ptychobranchus occidentalis appears to be surviving in portions of its former range. In particular sizable populations of this species can be found in Arkansas and Missouri. Smaller populations are present in Kansas and Oklahoma. Current information about the life history of *P. occidentalis* indicates that further study is required to form a complete understanding of this species. Although research to date has identified some potential hosts fishes for the this species, additional research is required to determine if there is variation in host preferences across the range of this species. Continued monitoring of known *P. occidentalis* populations for the impacts of non-native species, and habitat alterations is warranted.

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Figure 1. Distribution of *Ptychobranchus occidentalis* by county, based on a survey of museum records.